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09/986,919	11/13/2001	Jeawoan Lee	1567.1021	6274

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EXAMINER

RUTHKOSKY, MARK

ART UNIT PAPER NUMBER

1745

DATE MAILED: 08/09/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/986,919

Applicant(s)

LEE ET AL.

Examiner

Mark Ruthkosky

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 19 May 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-12 and 44-46 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 1-12 and 44-46 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-12 and 44 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In claim 1, the limitation “a current collector having pores comprising at or greater than 60% porosity and less than 90% porosity based on an overall volume of said current collector” is not taught in the original disclosure. There is no support in the specification to exclude a porosity of 90% greater or to eliminate the points of 60% and 90% from the disclosure (as taught in claims 3-4.) The numerical ranges in the original disclosure do not show that applicant possessed at the time the invention was made “less than 90% porosity”, as compared with at least 80-90% or “greater than 60% porosity.” Furthermore, the original disclosure does not include any data to appreciate that adding the language “less than 90% porosity” is significant to applicant’s invention. Claims depending from those rejected under 35 USC 112, first paragraph are further rejected by the same reasoning.

***Claim Objections***

Claim 46 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 46 only includes limitations with elements of claim 1.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5, 9-12 and 45-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Peled et al. (US Pat. No. 4,410,609.)

The present claims are drawn to a positive electrode comprising a sulfur based active material where the disclosed inventive concept appears to be a positive electrode porous current collector in which the sulfur based active material is disposed. The product-by-process limitations of claims 5, 9, and 10 are not given patentable weight since the courts have held that patentability is based on a product itself, even if the prior art product is made by a different process (see In re Thorpe, 227 USPQ 964, (CAFC 1985), In re Brown, 173 USPQ 685 (CCPA 1972), and In re Marosi, 218 USPQ 289, 292-293 (CAFC 1983)).

In claim 5, the product by process limitation “wherein said porous current collector comprises a resin foam coated with a metal, where the coated resin foam is subjected to a

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pyrolysis process” is not given patentable weight in a product claim. Therefore, a porous metallic current collector would meet the claim limitation.

In claim 9, the product by process limitation “wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating” is not given patentable weight in a product claim.

In claim 10, the product by process limitation “wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating” is not given patentable weight in a product claim.

Chu et al. disclose a lithium sulfur battery comprising a positive electrode comprising a current collector that can be a conductive foam or a thin conductive grid such as a metal-coated polymer fibers or weaves in which the positive electrode material is interspersed throughout the matrix provided by the current collector (col. 9, lines 15-37 and Figures 2A and 2B).

Conductive foam or thin conductive grid such as a metal coated polymer fibers or weaves inherently are porous since they provide a matrix in which the positive electrode material is interspersed. The reference also states that the matrix is sufficiently “open” that there is room for precipitated electroactive material to deposit on the matrix (col. 10, lines 39-56). The positive electrode material is interspersed through the matrix provided by the current collector (col. 9, lines 27-30). Current collector materials may be made of a material such as aluminum that is resist to degradation in the electrochemical environment of the cell (col. 8, lines 13-34).

The positive electrode material may be elemental sulfur, sulfides, polysulfides, redox sulfur polymers (col. 6, lines 5-42 and col. 19, lines 6-15), and  $\text{Li}_2\text{S}_x$  where x is a value of 1 or greater (col. 9, lines 40-55). The positive electrode material may be interspersed into the current

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collector material by providing a slurry containing the sulfur based active material, a suitable ionically conductive binder, electroconductive agent, and solvent (col. 17, lines 24-40) and coating the slurry onto a porous current collector such as carbon fiber paper (col. 17, lines 30-35) where the carbon fiber paper is impregnated with the slurry and the solvent is evaporated (col. 23, lines 23-50 and col. 19, lines 45-58). The ionically conductive polymer binder material may be PEO, PTFE, PAN, PVDF, among others (see col. 18, lines 50-end.) The electroconductive agent may be a carbon black, polyaniline, polythiophene, polyacetylene, polypyrrole, etc. and mixtures thereof (see col. 18, lines 35-50.)

The negative electrode material may be lithium metal, lithium alloy, carbon based-lithium ion that reversibly intercalates and deintercalates lithium ions (col. 21, lines 1-46). A separator separates the positive electrode and the negative electrode and may be glass, plastic, ceramic, or a polymeric entraining liquid electrolyte (col. 8, lines 43-61). The battery contains a liquid electrolyte containing a lithium salt which impregnates (permeates) the negative electrode, positive, electrode, and separator (col. 14, lines 43-67 and col. 16, lines 1-6) and where the electrolyte also transfers lithium metal ions (col. 10, lines 1-6). Chu et al. ('720) do not disclose that the current collector comprises at least 60% porosity and less than 90% porosity based on an overall volume of the current collector.

Peled et al. teach a lithium-sulfur battery comprising a porous positive electrode current where the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23). The current collector is charged with sulfur. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the current collector of Chu et al. ('720) to be 80% porous because such porosity would allow

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for high sulfur loading in the electrode, as noted in the reference, and would provide a cathode with high porosity so as to provide extensive electrolyte solvent communication throughout the bulk of the cathode, which gives improved ionic conductivity in the electrode and improved electrical conductivity with the current collector, which leads to improved battery performance.

Claims 1-5, 9-12 and 45-46 rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (US Patent No. 5,686,201) in view of Peled et al. (US Pat. No. 4,410,609).

The product-by-process limitations of claims 5, 9, and 10 are not given patentable weight as previously noted since the courts have held that patentability is based on a product itself, even if the prior art product is made by a different process (see In re Thorpe, 227 USPQ 964, (CAFC 1985), In re Brown, 173 USPQ 685 (CCPA 1972), and In re Marosi, 218 USPQ 289, 292-293 (CAFC 1983)).

Chu discloses a positive electrode containing active-sulfur based composite electrodes in a lithium sulfur battery (col. 1, lines 15-27 and col. 4, lines 29-60). The positive electrode comprises active sulfur (in the form of elemental sulfur in the examples provided in the reference), binder and a conductive agent such as carbon black (col. 5, lines 9-43). The current collector to which the positive electrode slurry is applied can be in the form of expanded metals, screens, meshes, and foams as is known in the art (col. 15, lines 3-20). The current collector can be made of aluminum, copper, titanium or other conductive material that would not react at operating cell conditions. The ionically conductive polymer material may be polyethylene oxide, PAN, PVDF, among others (see col. 5, lines 9-25 and col. 6, lines 1-25.) The electroconductive agent may be a carbon black, polyaniline, polythiophene, polyacetylene, polypyrrole, etc. (see

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col. 12, lines 20-30.) Chu et al. ('201) do not disclose that the current collector comprises at least 60% porosity and less than 90% porosity based on an overall volume of the current collector.

Peled et al. teach a lithium-sulfur battery comprising a positive electrode current collector that is porous and the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the current collector of Chu et al. ('201) to be 80% porous because such porosity would allow for high sulfur loading in the electrode, as noted in the reference, and would provide a cathode with high porosity so as to provide extensive electrolyte solvent communication throughout the bulk of the cathode, which gives improved ionic conductivity in the electrode and improved electrical conductivity with the current collector, which leads to improved battery performance.

With regard to claim 45, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine two electroconductive compositions such as carbon and a conductive polymer as taught in Chu, each of which is taught by the prior art to be useful for the same purpose, in order to form a composition which is to be used for the very same purpose, *In re Kerkhoven*, 205 USPQ 1069, 1072. The artisan would have found the claimed invention to be obvious in light of the teachings of the references.

Claims 6-8, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (US Patent No. 5,686,201) in view of Peled et al. (US Pat. No. 4,410,609) as applied to claims 1 and 5 above, and further in view of Kawakami (US Patent No. 6,475,664).



Chu et al. ('201) as modified by Peled et al. disclose all the limitations of claims 6-8, and 44 except that the metal foam comprises a carbon conductive agent other than the metal, that the porous current collector comprises the non-woven fabric coated with a metal, or that the porous current collector comprises a carbon fiber.

Kawakami disclose that current collectors in the form of a metal foam for a positive electrode of a battery can be obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like and such current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction (col. 13, lines 62-67 and col. 14, lines 1-14). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a metal foam as a current collector in the battery of Chu ('201) obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like because such metal foam current collectors efficiently supply an electric current consumed in or collect an electric

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current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction.

Claims 6-8, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Peled et al. (US Pat. No. 4,410,609), as applied to claims 1 and 5 above, and further in view of Kawakami (US Patent No. 6,475,664).

Chu et al. ('720) as modified by Peled et al. disclose all the limitations of claims 6-8, and 44 except that the metal foam comprises a carbon conductive agent other than the metal, that the porous current collector comprises the non-woven fabric coated with a metal, or that the porous current collector comprises a carbon fiber.

Kawakami disclose that current collectors in the form of a metal foam for a positive electrode of a battery can be obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like and such current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction (col. 13, lines 62-67 and col. 14, lines 1-14). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a metal foam as a current collector in the battery of Chu ('720) obtained by 1) coating the surface of a sheet-shaped organic polymer resin having a three

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dimensional network structure of urethane foam with a metal film of nickel or the like by means of plating or the like and subjecting the resultant to sintering to decompose and remove the polymer resin, or 2) obtained by coating the surface of a carbon fiber felt (which is a nonwoven fabric) with a metal film of nickel or the like by means of plating or the like because such metal foam current collectors efficiently supply an electric current consumed in or collect an electric current generated in the electrode reaction upon charging or recharging and are highly electrically conductive and inactive in a battery reaction.

### ***Response to Arguments***

Applicant's arguments filed 11/25/2005 have been fully considered but they are not persuasive.

*With respect to claims rejected under 35 USC 112, first paragraph, the applicant contends the range of at or greater than 60% and less than 90% is supported in claims 3-4 of the original disclosure.*

In response, the Examiner notes that this language is not found in original claims 3-4. Original claim 4 reads, "The positive electrode of claim 1, wherein the pores of said current collector comprise *at least 80 to 90% porosity* of an overall volume of said current collector." The term "at least" sets a lower limit on the porosity, but not an upper limit on the porosity. There is no support in the specification to exclude a porosity of 90% or greater. Further, there is no support for eliminating the point of 60%. Applicant argues that the term "at least" does not set an upper limit on the porosity, but that the term "to 90" sets this limit. This is not persuasive. Had the applicant claimed from 80-90% porosity with the intention of 90% as the upper limit,

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there would need to be no reason to include the phrase “at least.” The lower limit of the range would be 80% and the upper limit would be 90%. The phrase “at least” serves no other purpose other than to set the *lower limit* of the range to be 80-90%.

Due to the importance of each word in original claims 3-4 with regard to the disclosure, applicant is encouraged to use the language supported in the original claim to describe the porosity claimed invention. The numerical ranges in the original disclosure do not show that applicant possessed at the time the invention was made a range less than 90% porosity, but greater than or equal to 60%.

*With respect to art rejections based on Chu as modified by Peled, applicant asserts that the references do not teach the claimed binders.*

Applicant argues that claimed binders are not taught in the references cited in the rejections. These binders are taught in the prior art as noted in the rejections of record.

#### ***Examiner Correspondence***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark Ruthkosky whose telephone number is 571-272-1291. The examiner can normally be reached on FLEX schedule (generally, Monday-Thursday from 9:00-6:30.) If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications


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may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Mark Ruthkosky

Primary Patent Examiner

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8.2.2006